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ABSTRACT

Described is a study of the technical manpower spectrum. Particularly examined is the information collected from industry concerning how technically-trained people are used. Data on training appropriateness for particular job requirements are also examined. Conclusions are intended to assist educational institutions in formulating policy to better train and educate pre-service engineering technologists. (Author/RE)

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THE ENGINEERING TECHNOLOGIST

AS VIEWED

BY

EMPLOYERS AND EDUCATORS

AN ANALYTICAL SURVEY

conducted

by

Dr. Joics Stone, Professor
Behavioral Science Dept.

California State Polytechnic University, Pomona
Pomona, California

July, 1975

Report NSF/CP No. 2

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INTRODUCTION

A necessary ingredient in program development is knowing the nature of the technical manpower spectrum. The following study is an attempt to determine this by obtaining information from industry as to how they use technically trained people, as well as deciding what training is most appropriate for certain job requirements. We are particularly concerned about the following:

1. General relationships of the research-production team.
2. Alignment of various engineering and related qualities with respect to:

   (a) The engineering technologist
   (b) Production management
   (c) The proper man for the job

3. Particular involvements of the research-production team members with specific functions.

In order to obtain useful information about the engineering technologist, a survey instrument was developed and presented to a sample total of 453 technical people representing 262 organizations in the areas of manufacturing, construction, and education. The sample characteristics are presented in Table 1 below.

TABLE 1. SAMPLING CHARACTERISTICS

FEATURE	MANUFACTURING	CONSTRUCTION	FACULTY	TOTAL
N	202	176	75	453
PHD	16	2	28	46
MS	36	33	43	112
BS	131	138	4	273
AA	14	3	0	17
HS	5	0	0	5
AVERAGE	48.7	54.2	46.6	50.1
ORGANIZATIONS	168	83	11	262
TOTAL POSITIONS OF EXPERIENCE	348	220	112	670

The reports (Part I and Part II) that follow the survey instrument will summarize the views of the respondents. These views will help educational institutions formulate policy to better educate and train would-be engineering technologists for the "research-production team".

THE SURVEY INSTRUMENT

CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

3801 West Temple Avenue *Pomona, California 91768*

Dear Sir:

California State Polytechnic University, Pomona has been administering an NSF Grant for Engineering Technology. This Grant provides for implementing and evaluating courses and experiences designed to provide a Bachelor's Degree in Engineering Technology.

A major stipulation of the NSF Grant is that we make an assessment of the current situation of the research-production team. We are charged to determine also, the role of the Engineering Technologist in that team, if such a role exists.

The enclosed survey was designed to make a comprehensive analysis of that situation. We solicit your assistance in completing that survey. It will take approximately one hour for you to respond to these items. We know that such time is valuable, but we hope that you will view this research project as valuable enough in its thrust to warrant your cooperation.

Enclosed also is a bio-data sheet that will help us describe more adequately the kinds of persons responding. We would appreciate it if you would fill it out too. On that sheet you may indicate your interest in receiving a copy of the results of the study.

Sincerely yours,

Joics B. Stone, Ph.D.
Professor, Psychology

Melvin B. Belcher, Professor
Electrical Engineering Department
Principal Investigator, NSF Project

Enclosures

THE RESEARCH-PRODUCTION TEAM:

DIRECTIONS, EXPECTATIONS, AND IMPLICATIONS

AN ANALYTICAL SURVEY
CONDUCTED BY

SCHOOL OF ENGINEERING

CALIFORNIA STATE POLYTECHNIC UNIVERSITY
POMONA

NOVEMBER 1, 1973

THE RESEARCH-PRODUCTION TEAM: DIRECTIONS, EXPECTATIONS, AND IMPLICATIONS

One of the most interesting elements of modern civilization is the complex area called "technology". It represents an interface of advances in knowledge, research, applications, and innovations. And the benefits attributed to technology are legion. Even so, its genesis is not clearly traced. The chart below presents a capsule review of technology as it has grown with and from artistry since the dark ages.

DATES	ARTISTRY	UTILITY/ PRACTICALITY	EFFICIENCY/ VERSATILITY	FEATURES
1200-1500	ARTISAN/CRAFTSMAN			GUILDS: COMMERCIAL REVOLUTION
1500-1700	ARTISAN	CRAFTSMAN	ENGINEER	EXPLORATION: CIVIL-MILITARY REVOLUTION
1750	ARTISAN	CRAFTSMAN	MECHANIC (TECHNICIAN) / ENGINEER	STEAM: INDUSTRIAL REVOLUTION
1850	ARTISAN	CRAFTS-MAN / TECH-NICIAN	ENGI-NEER / SCIEN-TIST	EXPERIMENTATION: SCIENTIFIC REVOLUTION
1915	ART-ISAN / CRAFTS-MAN	OPER-ATOR / TECH-NICIAN	ENGI-NEER / SCIEN-TIST	ASSEMBLY LINE: PRODUCTION REVOLUTION I
1965	ART-ISAN/ CRAFTS-MAN / OPER-ATOR	TECH-NICIAN / ENGI-NEERING TECHNO-LOGIST	ENGI-NEER / SCIEN-TIST	COMPUTER/AUTOMATION: PRODUCTION REVOLUTION II
1990	ARTISAN/CRAFTSMAN/ENGINEER/SCIENTIST			ECOTILITY/ PRIORITIES: ETHICAL REVOLUTION
	OPERATOR	TECHNICIAN	ENGINEERING TECHNOLOGIST	

As time progressed, specialization increased, advancing with each new feature. Initially, the time gap between "revolutions" spanned centuries; now, the gap barely spans generations. This speeding up process has seen the development of increasing mechanization, automation, and complex efficiency. One result of this speed-up has been the creation of a new member of the production team, the engineering technologist, who bridges the gap between the creativity of the engineer and the utility of the operator-technician members of the team.

In addition, the next two decades may well generate a great emphasis on "ecotility", the economic utilization of all of our material and human resources based on intricately validated priorities. Such a development could produce a production team looking like the 1990 presentation above. The engineering technologist might well increase in functional capability, and the engineer might become more broadly aligned as a creative professional across the full "ecotility" spectrum.

This present survey is an attempt to determine the present status of the 1965 spectrum, above. We are concerned with these particular emphases:

1. General relationships of the research-production team.
2. Alignment of various engineering and related qualities with respect to:

   (a) The Engineering Technologist
   (b) Production Management
   (c) The Proper Man For The Job

3. Particular involvements of the research-production team members with specific functions.

The following pages are devoted to soliciting your opinions on various ramifications of those three emphases. We would appreciate your candid, considered opinions. We hope to gain substantive information which can be used to formulate a clearer picture of how the research-production team is currently viewed by those who belong to, work with, or supervise that team. The general results of this survey will be supplied to you if you wish. You may indicate such a desire on the accompanying data sheet.

EMPHASES OF RESEARCH-PRODUCTION TEAM

The table below lists several general emphases encompassed by the research-production team. Those emphases are not defined nor elaborated on beyond the terms as they are listed. As you use those terms, we would appreciate your response to the instructions on the table. For example, as you understand the term "IDEAS", do you consider the SCIENTIST to have maximal (M) concern for them, substantial (S) concern, or nominal (N) concern. Continue with each of the positions and each of the eight other emphases.

EMPHASES OF RESEARCH - PRODUCTION TEAM

EMPHASIS...Place an "M" (Maximal), "S" (Substantial), or "N" (Nominal) as your evaluation of the extent each person (position) is concerned with each emphasis.	POSITION				
	SCIENTIST	ENGINEER	TECHNOLOGIST	TECHNICIAN	OPERATOR
1. IDEAS					
2. SOLUTIONS (ANALYTICAL)					
3. SOLUTIONS (APPLIED)					
4. APPLICATIONS					
5. DATA - GATHERING					
6. EVALUATION					
7. SPHERE OF INFLUENCE					
8. PHYSICAL SKILLS					
9. EDUCATIONAL TRAINING					

RESEARCH/PRODUCTION TEAM QUESTIONNAIRE

This section delineats a wide range of knowledges and skills required to greater or lesser degress by members of the research-production team. The list has these groupings:

1. Engineering Qualities...basic knowledges and skills included in the general connotation of "engineering training".
2. Management Qualities...basic skills, knowledges, and functions aligned with "management training".
3. Problem-solving Qualities...basic skills, knowledges, and functions involved in creative and trouble-shooting approaches to problems.
4. Intra-personal Qualities...areas of maturity particularly important in directing and controlling oneself.
5. Inter-personal Qualities...areas of functioning especially important in interacting with other people.
6. Supra-personal Qualities...skills and functions needed in effective involvements with organizations, one's culture, and creative independence.

In addition to those varied qualities, we are concerned with special applications for each of them to: (1) the Engineering Technologist, (2) Production Management, and (3) the proper man for the job (quality).

These instructions may expedite your completion of this section.

1. Take each "quality" in turn and respond to "THE ENGINEERING TECHNOLOGIST NEEDS"; e.g., for Applications of Basic Physics", do you consider that the Engineering Technologist needs to know such information "Little" (1), "Moderate" (2), or "Much" (3)? Proceed through the entire list of qualities, orienting to the Engineering Technologist.
2. After completing the Supra-personal Qualities on page 11 for the Engineering Technologist, turn back to page 5.
3. Beginning again with "Applications of Basic Physics", indicate its importance, in your opinion, for Production Management; either NO (not particularly important), or SOME or MUCH. Continue again through the next pages, referring continually to Production Management needs.
4. Upon completing the qualities on page 11, return to page 5 and orient to the columns headed PROPER MAN FOR JOB. Referring again to "Applications of Basic Physics", designate which person you think needs that quality most. Proceed through the list again.
5. Upon completing page 11, continue right on.

RESEARCH/PRODUCTION TEAM QUESTIONNAIRE

ENGINEERING QUALITIES: Record your response by circling the one you choose to mark in each instance.	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
1. Applications of Basic Physics	1	2	3	N	S	M	E	ET.	T	1
2. Applications of Basic Chemistry	1	2	3	N	S	M	E	ET.	T	2
3. Applications of Basic Calculus	1	2	3	N	S	M	E	ET.	T	3
4. Applications of Basic Spoken Communication	1	2	3	N	S	M	E	ET.	T	4
5. Applications of Basic Written Communication	1	2	3	N	S	M	E	ET.	T	5
6. Applications of Basic Objective Data-Processing	1	2	3	N	S	M	E	ET.	T	6
7. Applications of Basic Aerospace Engineering	1	2	3	N	S	M	E	ET.	T	7
8. Applications of Basic Civil Engineering	1	2	3	N	S	M	E	ET.	T	8
9. Applications of Basic Electrical/ Electronic Engineering	1	2	3	N	S	M	E	ET.	T	9
10. Applications of Basic Industrial Engineering	1	2	3	N	S	M	E	ET.	T	10
11. Applications of Basic Mechanical Engineering	1	2	3	N	S	M	E	ET.	T	11
12. Applications of Basic Manufacturing Engineering	1	2	3	N	S	M	E	ET.	T	12
13. Applications of Basic Spatial Visualization (Graphics)	1	2	3	N	S	M	E	ET.	T	13

ENGINEERING QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
14. Applications of Basic Systems Theory	1	2	3	N	S	M	E	ET.	T	14
15. Applications of Basic Ecological (Environmental) Control	1	2	3	N	S	M	E	ET.	T	15
16. Applications of Basic Engineering Economics	1	2	3	N	S	M	E	ET.	T	16
17. Applications of Basic Design Theory	1	2	3	N	S	M	E	ET.	T	17
MANAGEMENT QUALITIES										
1. Functioning in Line Relationships	1	2	3	N	S	M	E	ET.	T	1
2. Functioning in Staff Relationships	1	2	3	N	S	M	E	ET.	T	2
3. Functioning with Formalized Functional Controls	1	2	3	N	S	M	E	ET.	T	3
4. Formulating of Short-Range Plans	1	2	3	N	S	M	E	ET.	T	4
5. Formulating of Long-Range Plans	1	2	3	N	S	M	E	ET.	T	5
6. Ability to Advise and Counsel Objectively	1	2	3	N	S	M	E	ET.	T	6
7. Effective Delegating of Assignments	1	2	3	N	S	M	E	ET.	T	7
8. Acceptance of Responsibility for Actions	1	2	3	N	S	M	E	ET.	T	8

MANAGEMENT QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR.	TECHN.	
9. Acceptance of Accountability for Decisions	1	2	3	N	S	M	E	ET.	T	9
10. Ability to Choose Subordinates Wisely	1	2	3	N	S	M	E	ET.	T	10.
11. Ability to Train Peers and Subordinates Effectively	1	2	4	N	S	M	E	ET.	T	11
12. Ability to Evaluate Other's Performance Objectively	1	2	3	N	S	M	E	ET.	T	12
13. Ability to Motivate Peers and Subordinates	1	2	3	N	S	M	E	ET.	T	13
14. Preparation of Daily/Weekly Agendas	1	2	3	N	S	M	E	ET.	T	14
15. Ability to Conduct Peer and/or Subordinate Conferences	1	2	3	N	S	M	E	ET.	T	15
16. Application of Basic Accounting Principles	1	2	3	N	S	M	E	ET.	T	16
17. Application of Basic Commercial Law Principles	1	2	3	N	S	M	E	ET.	T	17
PROBLEM - SOLVING QUALITIES										
1. Observational Skill Focus on Details/Totalities	1	2	3	N	S	M	E	ET.	T	1
2. Application of Intellectual Skills to Practical and Theoretical	1	2	3	N	S	M	E	ET.	T	2
3. Develop Concepts and Meanings on a Realistic Base	1	2	3	N	S	M	E	ET.	T	3

PROBLEM - SOLVING QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
4. Determine "Priorities" on Logical Objective Basis	1	2	3	N	S	M	E	ET.	T.	4
5. Ability to Analyze and Generalize Day-to-Day Activities	1	2	3	N	S	M	E	ET.	T	5
6. Accurately Observes Routine Activities	1	2	3	N	S	M	E	ET.	T	6
7. Application of Suspended and Empirical Judgment	1	2	3	N	S	M	E	ET.	T	7
8. Generates Clear Reports of Activites and Processes	1	2	3	N	S	M	E	ET.	T	8
9. Generates Effective Designs for Studying Problems	1	2	3	N	S	M	E	ET.	T	9
10. Use of Effective Data-Handling Processes	1	2	3	N	S	M	E	ET.	T	10
11. Determination of "Trends" in Production Processes/ Output	1	2	3	N	S	M	E	ET.	T	11
12. Generating of "New" Ideas for Production Operations	1	2	3	N	S	M	E	ET.	T	12
13. Translating of "New" Ideas Into Processes/Applications	1	2	3	N	S	M	E	ET.	T.	13
14. Use of General Library Systems in Handling Problems	1	2	3	N	S	M	E	ET.	T	14
15. Ability to Diagnose (Trouble-Shoot)Production Problems	1	2	3	N	S	M	E	ET.	T	15
INTRA-PERSONAL (SELF-DIRECTING) QUALITIES										
1. Strong Physical/Emotional Energy Supply	1	2	3	N	S	M	E	ET.	T	1
2. Bounces Back Readily in Response to Time/Energy Pressures	1	2	3	N	S	M	E	ET.	T.	2

INTRA-PERSONAL (SELF-DIRECTING) QUALITIES	THE ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
3. Maintains Strong "Drives" on Sustained Basis	1	2	3	N	S	M	E	ET.	T	3
4. Adapts Readily to Emergency Situations	1	2	3	N	S	M	E	ET.	T	4
5. Has Sustained Long-Range Basic Goal Structure	1	2	3	N	S	M	E	ET.	T	5
6. Attacks "Barriers" Positively and Directly	1	2	3	N	S	M	E	ET.	T	6
7. Deals with His World with A Sense of Appreciation	1	2	3	N	S	M	E	ET.	T	7
8. Expects Maximum (Optimism) from Life and Work	1	2	3	N	S	M	E	ET.	T	8
9. Personal Value - System Based on High-Value Elements	1	2	3	N	S	M	E	ET.	T	9
10. Reacts to Annoyance with Mature Sense of Humor	1	2	3	N	S	M	E	ET.	T	10
11. Effectively Plans and Controls His Time	1	2	3	N	S	M	E	ET.	T	11
12. Easily "Unwinds" in Day-to-Day Activities	1	2	3	N	S	M	E	ET.	T	12
13. Effectively Uses Basic Tools (Reading, Thinking, Etc.)	1	2	3	N	S	M	E	ET.	T	13
14. Reacts to Differing or Opposing Views Tolerantly	1	2	3	N	S	M	E	ET.	T	14
INTERPERSONAL (HUMAN RELATIONS) QUALITIES										
1. Interacts with Dignity Toward Himself and Others	1	2	3	N	S	M	E	ET.	T	1
2. Willing to Interact with All Kinds of People	1	2	3	N	S	M	E	ET.	T	2

INTERPERSONAL (HUMAN RELATIONS) QUALITIES	THE ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
3. Communicates with Others Fluently and Clearly	1	2	3	N	S	M	E	ET.	T	3
4. Accepts Others as They are without Suspicion	1	2	2	N	S	M	E	ET.	T	4
5. Comfortable in a Wide-Range of Interpersonal Settings	1	2	3	N	S	M	E	ET.	T	5
6. Exhibits Effective, Gregarious Involvement with Others	1	2	3	N	S	M	E	ET.	T	6
7. Handles Realities of Success/Failure with Confidence	1	2	3	N	S	M	E	ET.	T	7
8. Sense of Satisfaction from Daily Activities	1	2	3	N	S	M	E	ET.	T	8
9. Approaches Daily Activities with Positive Feelings	1	2	3	N	S	M	E	ET.	T	9
10. "Rolls" with Physical/Emotional Hurt (Rides it Out)	1	2	3	N	S	M	E	ET.	T	10
11. Effective Listener in Interacting with Others	1	2	3	N	S	M	E	ET.	T	11
12. Effective Teacher in Interacting with Others	1	2	3	N	S	M	E	ET.	T	12
13. Effective in Leading and Following	1	2	3	N	S	M	E	ET.	T	13
SUPRA-PERSONAL (CULTURAL/CREATIVE) QUALITIES										
1. Anchors Ethical Principles to Idealistic Base	1	2	3	N	S	M	E	ET.	T	1
2. Employs Effective Self-Discipline (Internalized)	1	2	3	N	S	M	E	ET.	T	2

SUPRA-PERSONAL (CULTURAL/CREATIVE) QUALITIES	THE ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECH.	
3. Accepts Prevailing Practices and Customs Readily	1	2	3	N	S	M	E	ET	T	3
4. Exhibits Broad Range of Personal Interests	1	2	3	N	S	M	E	ET	T	4
5. Reacts to "New" Ideas/Practices with Open Mind	1	2	3	N	S	M	E	ET	T	5
6. Exhibits a Wide Range of Knowledge Competencies	1	2	3	N	S	M	E	ET	T	6
7. Employs Active Intellectual Curiosity	1	2	3	N	S	M	E	ET	T	7
8. Rises to Positive Challenges in Daily Activities	1	2	3	N	S	M	E	ET	T	8
9. Effectively "Time-Oriented" (Sense of Past, Present, Future)	1	2	3	N	S	M	E	ET	T	9
10. Easily Generates "Brainstorming" outputs	1	2	3	N	S	M	E	ET	T	10
11. Effectively Uses "Critical Incident" Techniques	1	2	3	N	S	M	E	ET	T	11
12. Exhibits an Integrated Basic Philosophy of Life	1	2	3	N	S	M	E	ET	T	12
13. Accepts Personal Responsibility (Concern) for Commitment	1	2	3	N	S	M	E	ET	T	13

RETURN TO PAGE 5 RETURN TO PAGE 5 CONTINUE ON TO PAGE 12

RESEARCH/PRODUCTION TEAM INVOLVEMENTS

This section is concerned with the extent to which specific functions are appropriately performed by particular members of the Research/Production Team.

These instructions apply:

Review each FUNCTION/RESPONSIBILITY/TASK in turn and circle any of the symbols representing the job title(s) you feel perform(s) the respective function. This code applies throughout this section:

S . . . Scientist
E . . . Engineer
ET. . . Engineering Technologist
T . . . Technician
O . . . Operator

	FUNCTION/RESPONSIBILITY/TASK					
1.	Implements and monitors varied interlinking process-operations under pre-planned instructions.	S	E	ET	T	O
2.	Directs investigations concerned with complex process-operations ("trouble-shooting").	S	E	ET	T	O
3.	Adjusts process-operations to maintain a precise, routine functioning.	S	E	ET	T	O
4.	Develops "quality-control", structure for monitoring complex process-operations.	S	E	ET	T	O
5.	Concerned with "whys and hows" of complex process-operations in terms of their versatility and practicability.	S	E	ET	T	O
6.	Has moderate vertical, direct-line influence and limited horizontal staff influence.	S	E	ET	T	O
7.	Concerned with the effectiveness of operational systems applications to complex functions.	S	E	ET	T	O
8.	Has wide-range vertical and horizontal staff influence, limited direct-line influence.	S	E	ET	T	O
9.	Concerned with "whys and hows" of routine process-operations in terms of their efficiency and effectiveness.	S	E	ET	T	O
10.	Generates and monitors process-designs for exploring the unknown.	S	E	ET	T	O
11.	Directs investigations of probable (possible) adaptations of broad principles to varied complex process-operations	S	E	ET	T	O

	FUNCTION/RESPONSIBILITY/TASK				
12.	Has limited vertical direct-line influence and limited horizontal staff influence.	S	E	ET	0
13.	Concerned with "whys and hows" of complex process-operations in terms of their efficiency and effectiveness.	S	E	ET	0
14.	Concerned with maintaining specific standards in routine process-operations.	S	E	ET	0
15.	Concerned with assembling comprehensive data-input capable of reflecting status of on-going complex process-operations.	S	E	ET	0
16.	Explores the new frontiers related to process-operations.	S	E	ET	0
17.	Concerned with generating generalized trends, principles, and concepts relevant to process-operations.	S	E	ET	0
18.	Maintains a varied, adaptive, interchanging set of process-operations.	S	E	ET	0
19.	Implements and monitors routinized process-operations according to pre-planned instructions.	S	E	ET	0
20.	Concerned with assembling limited range of data-input reflecting status of on-going process-operations.	S	E	ET	0
21.	Creates prototypes for complex process-operations.	S	E	ET	0
22.	Directs investigations concerned with "trouble-shooting" a limited variety of process-operations.	S	E	ET	0
23.	Concerned with "whys and hows" of general process-operations with particular emphasis on their utility.	S	E	ET	0
24.	Directs investigations of broad principles underlying general process-operations.	S	E	ET	0
25.	Generates and monitors process-designs directed toward meeting "needs."	S	E	ET	0
26.	Concerned with assembling wide-range data-input related to establishing generalized principles and applications.	S	E	ET	0
27.	Generates innovative features in maintaining and monitoring complex process-operations.	S	E	ET	0

FUNCTION/RESPONSIBILITY/TASK					
28. Has wide-range vertical direct-line influence, moderate horizontal staff influence.	S	E	ET	T	0
29. Concerned with assembling comprehensive data-input capable of reflecting potential/ capability of complex process-operations.	S	E	ET	T	0
30. Concerned with "whys and hows" of general process-operations irrespective of their apparent utility.	S	E	ET	T	0
31. Has wide-range vertical, direct-line influence, limited horizontal staff influence	S	E	ET	T	0
32. Concerned with implementing specific standards for varied process-operations.	S	E	ET	T	0
33. Concerned with assembling routinized, specific data-input reflecting status of on-going process-operations.	S	E	ET	T	0
34. Directs investigations concerned with "trouble-shooting" a specific, routine set of process-operations.	S	E	ET	T	0
35. Adapts "needs" and process-designs to operational systems.	S	E	ET	T	0

GENERAL COMMENTS:

Please note here any features, aspects or comments you wish to make concerning the Engineering Technologist as a concept or in function.

PART I

"PRELIMINARY REPORT"

THE RESEARCH-PRODUCTION TEAM:

DIRECTIONS, EXPECTATIONS, AND IMPLICATIONS

Joics B. Stone
and
Melvin B. Belcher

AN ANALYTICAL SURVEY
CONDUCTED BY

SCHOOL OF ENGINEERING

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THE RESEARCH-PRODUCTION TEAM: DIRECTIONS, EXPECTATIONS, AND IMPLICATIONS

One of the most interesting elements of modern civilization is the complex area called "technology". It represents an interface of advances in knowledge, research, applications, and innovations. And the benefits attributed to technology are legion. Even so, its genesis is not clearly traced. The chart below presents a capsule review of technology as it has grown with and from artistry since the dark ages.

DATES	ARTISTRY	UTILITY/ PRACTICALITY	EFFICIENCY/ VERSATILITY	FEATURES
1200-1500	ARTISAN/CRAFTSMAN			GUILDS: COMMERCIAL REVOLUTION
1500-1700	ARTISAN	CRAFTSMAN	ENGINEER	EXPLORATION: CIVIL-MILITARY REVOLUTION
1750	ARTISAN	CRAFTSMAN	MECHANIC (TECHNICIAN) / ENGINEER	STEAM: INDUSTRIAL REVOLUTION
1850	ARTISAN	CRAFTS-MAN	TECH-NICIAN / ENGI-NEER / SCIEN-TIST	EXPERIMENTATION: SCIENTIFIC REVOLUTION
1915	ART-ISAN	CRAFTS-MAN	OPER-ATOR / TECH-NICIAN / ENGI-NEER / SCIEN-TIST	ASSEMBLY LINE: PRODUCTION REVOLUTION I
1965	ART-ISAN/ CRAFTS-MAN	OPER-ATOR	TECH-NICIAN / ENGI-NEERING TECHNO-LOGIST / ENGI-NEER / SCIEN-TIST	COMPUTER/AUTOMATION: PRODUCTION REVOLUTION II
1990	ARTISAN/CRAFTSMAN/ENGINEER/SCIENTIST			ECOTILITY/ PRIORITIES: ETHICAL REVOLUTION
	OPERATOR	TECHNICIAN	ENGINEERING TECHNOLOGIST	

As time progressed, specialization increased, advancing with each new feature. Initially, the time gap between "revolutions" spanned centuries; now, the gap barely spans generations. This speeding up process has seen the development of increasing mechanization, automation, and complex efficiency. One result of this speed-up has been the creation of a new member of the production team, the engineering technologist, who bridges the gap between the creativity of the engineer and the utility of the operator-technician members of the team.

In addition, the next two decades may well generate a great emphasis on "ecotility", the economic utilization of all of our material and human resources based on intricately validated priorities. Such a development could produce a production team looking like the 1990 presentation above. The engineering technologist might well increase in functional capability, and the engineer might become more broadly aligned as a creative professional across the full "ecotility" spectrum.

This present survey is an attempt to determine the present status of the 1965 spectrum, above. We are concerned with these particular emphases:

1. General relationships of the research-production team.
2. Alignment of various engineering and related qualities with respect to:

   (a) The Engineering Technologist
   (b) Production Management
   (c) The Proper Man For The Job

3. Particular involvements of the research-production team members with specific functions.

TABLE 1. SAMPLING CHARACTERISTICS

FEATURE	MANUFACTURING	CONSTRUCTION	FACULTY	TOTAL
N	202	176	75	453
PHD	16	2	28	46
MS	36	33	43	112
BS	131	138	4	273
AA	14	3	0	17
HS	5	0	0	5
AVE AGE	48.7	54.2	46.6	50.1
ORGANIZATIONS	168	83	11	262
TOTAL POSITIONS OF EXPERIENCE	348	220	112	670

TABLE 2. EMPHASES OF RESEARCH-PRODUCTION TEAM

EMPHASIS	POSITION				
	SCIENTIST	ENGINEER	TECHNOLOGIST	TECHNICIAN	OPERATOR
IDEAS	6.7	6.7	3.7	1.0	1.0
SOLUTIONS (ANALYTICAL)	6.7	7.0	3.0	1.3	1.0
SOLUTIONS (APPLIED	3.7	6.3	5.7	2.3	1.3
APPLICATIONS	2.7	5.3	5.0	3.0	3.0
DATA-GATHERING	4.7	5.7	4.7	4.0	1.3
EVALUATION	6.3	7.0	4.7	2.3	1.0
SPHERE OF INFLUENCE	6.0	6.7	4.3	2.0	1.0
PHYSICAL SKILLS	1.3	1.7	4.7	6.3	7.0
EDUCATIONAL TRAINING	7.0	6.7	4.3	1.7	1.0

Maximal	7
Maximal, Minus	6
Substantial, Plus	5
Substantial	4
Substantial, Minus	3
Nominal, Plus	2
Nominal	1

TABLE 3

ENGINEERING TECHNOLOGIST

TABLE 3 (continued)

ENGINEERING TECHNOLOGIST

INTRA-PERSONAL (SELF-DIRECTING) QUALITIES		INTER-PERSONAL (HUMAN RELATIONS) QUALITIES		SUPRA-PERSONAL (CULTURAL/ CREATIVE) QUALITIES	
1	Strong Energy Supply	1	Dignity toward Others.	1	Ethical Principles.
2	Resiliency	2	Willing to Interact w/Others	2	Self-discipline.
3	Sustained Drive.	3	Effective in Communication	3	Conventionality.
4	Adapt to Emergency.	4	Acceptance of Others	4	Range of Interests.
5	Long-range Basic Goals	5	Social Versatility.	5	Reaction to New Ideas.
6	Attacks Barriers Positively.	6	Involvement w/Others	6	Knowledge Versatility.
7	Sense of Appreciation.	7	Realistically Confident	7	Intellectual Curiosity
8	Expects Maximum.	8	Sense of Satisfaction.	8	Rise to Positive Challenges.
9	High-value Elements	9	Positive Feelings	9	Effectively "Time-Oriented"
10	Sense of Humor	10	Reaction to Hurt/Stress	10	Brainstorming
11	Effective Time Use.	11	Listening Effectiveness	11	"Critical Incident" Use
12	Unwinds Easily	12	Teaching Effectiveness	12	Integrated Basic Philosophy.
13	Basic Tools Use.	13	Leader and Follower	13	Commitment
14	Tolerance of Differences.				

TABLE 4 (continued)

PRODUCTION MANAGEMENT

INTRA-PERSONAL (SELF-DIRECTING) QUALITIES	INTER-PERSONAL (HUMAN RELATIONS) QUALITIES	SUPRA-PERSONAL (CULTURAL/ CREATIVE) QUALITIES
1 Strong Energy Supply.	1 Dignity Toward Others	1 Ethical Principles . . . . .
2 Resiliency	2 Willing to Interact w/Others	2 Self-Discipline . . . . .
3 Sustained Drive	3 Effective in Communication.	3 Conventionality . . . . .
4 Adapt to Emergency	4 Acceptance of Others.	4 Range of Interests . . . . .
5 Long-Range Basic Goals	5 Social Versatility	5 Reaction to New Ideas . . . . .
6 Attacks Barriers Positively	6 Involvement w/Others.	6 Knowledge Versatility . . . . .
7 Sense of Appreciation	7 Realistically Confident.	7 Intellectual Curiosity . . . . .
8 Expects Maximum	8 Sense of Satisfaction	8 Rise to Positive Challenges . . . . .
9 High-Value Elements	9 Positive Feelings.	9 Effectively "Time-Oriented" . . . . .
10 Sense of Humor.	10 Reaction to Hurt/Stress.	10 Brainstorming . . . . .
11 Effective Time Use	11 Listening Effectiveness.	11 "Critical Incident" Use. . . . .
12 Unwinds Easily.	12 Teaching Effectiveness	12 Integrated Basic Philosophy . . . . .
13 Basic Tools Use	13 Leader and Follower	13 Commitment . . . . .
14 Tolerance of Differences		

TABLE 4

PRODUCTION MANAGEMENT

PROBLEM-SOLVING QUALITIES	MANAGEMENT QUALITIES	ENGINEERING QUALITIES
1 Observational Skill	1 Line Relationships	1 Basic Physics
2 Intellectual Skills	2 Staff Relationships	2 Basic Chemistry
3 Concept Development	3 Formal Controls	3 Basic Calculus
4 Priority Determination	4 Short-Range Plans	4 Basic Spoken Communication
5 Analysis of Day-to-Day	5 Long-Range Plans	5 Basic Written Communication
6 Routine Observation	6 Advise & Counsel	6 Basic Data-Processing
7 Suspended Judgment	7 Delegating	7 Basic Aero Engr
8 Reporting Efficiency	8 Responsibility	8 Basic Civil Engr
9 Problem Design	9 Accountability	9 Basic EE/EEE Engr
10 Effective Data-Handling	10 Choose Subordinates	10 Basic Industrial Engr
11 Trend Analysis	11 Train Personnel	11 Basic Mechanical Engr
12 Production of New Ideas	12 Evaluate Personnel	12 Basic Manufacturing Engr
13 Translation to Processing	13 Motivate Personnel	13 Basic Graphics
14 General Library Systems	14 Agenda Preparation	14 Basic Systems Theory
15 Trouble-Shooting	15 Conduct Conferences	15 Basic Ecological Control
	16 Basic Accounting	16 Basic Engr. Economics
	17 Basic Commercial Law	17 Basic Design Theory

TABLE 5

PROPER MAN FOR "QUALITIES"

PROBLEM-SOLVING QUALITIES	MANAGEMENT QUALITIES	ENGINEERING QUALITIES
1 Observational Skill	1 Line Relationships	1 Basic Physics
2 Intellectual Skills	2 Staff Relationships	2 Basic Chemistry
3 Concept Development	3 Formal Controls	3 Basic Calculus
4 Priority Determination	4 Short-Range Plans	4 Basic Spoken Communication
5 Analysis of Day-to-Day	5 Long-Range Plans	5 Basic Written Communication
6 Routine Observation	6 Advise & Counsel	6 Basic Data-Processing
7 Suspended Judgment	7 Delegating	7 Basic Aero. Engr
8 Reporting Efficiency	8 Responsibility	8 Basic Civil Engr
9 Problem Design	9 Accountability	9 Basic EE/EEE Engr
10 Effective Data-Handling	10 Choose Subordinates	10 Basic Industrial Engr
11 Trend Analysis	11 Train Personnel	11 Basic Mechanical Engr
12 Production of New Ideas	12 Evaluate Personnel	12 Basic Manufacturing Engr
13 Translation to Processing	13 Motivate Personnel	13 Basic Graphics
14 General Library Systems	14 Agenda Preparation	14 Basic Systems Theory
15 Trouble-Shooting	15 Conduct Conferences	15 Basic Ecological Control
	16 Basic Accounting	16 Basic Engr. Economics
	17 Basic Commercial Law	17 Basic Design Theory

TABLE 5 (continued)

PROPER MIX FOR "QUALITIES"

SUPRA-PERSONAL (CULTURAL/ CREATIVE) QUALITIES	INTER-PERSONAL (HUMAN RELATIONS)	INTRA-PERSONAL (CULTURAL/ CREATIVE) QUALITIES
1 Ethical Principles	1 Dignity Toward Others	1 Strong Energy Supply.
2 Self-Discipline	2 Willing to Interact w/Others	2 Resiliency
3 Conventionality	3 Effective in Communication.	3 Sustained Drive
4 Range of Interests	4 Acceptance of Others.	4 Adapt to Emergency
5 Reaction to New Ideas	5 Social Versatility	5 Long-Range Basic Goals
6 Knowledge Versatility	6 Involvement w/Others.	6 Attacks Barriers Positively
7 Intellectual Curiosity	7 Realistically Confident.	7 Sense of Appreciation
8 Rise to Positive Challenges	8 Sense of Satisfaction	8 Expects Maximum
9 Effectively "Time-Oriented"	9 Positive Feelings.	9 High-Value Elements
10 Brainstorming	10 Reaction to Hurt/Stress.	10 Sense of Humor.
11 "Critical Incident" Use.	11 Listening Effectiveness.	11 Effective Time Use
12 Integrated Basic Philosophy	12 Teaching Effectiveness	12 Unwinds Easily.
13 Commitment	13 Leader and Follower	13 Basic Tools Use
		14 Tolerance of Differences

RESEARCH/PRODUCTION TEAM INVOLVEMENTS

This section is concerned with the extent to which specific functions are appropriately performed by particular members of the Research/Production Team.

These instructions apply:

Review each FUNCTION/RESPONSIBILITY/TASK in turn and circle any of the symbols representing the job title(s) you feel perform(s) the respective function. This code applies throughout this section:

S . . . Scientist
E . . . Engineer
ET. . . Engineering Technologist
T . . . Technician
O . . . Operator

	FUNCTION/RESPONSIBILITY/TASK					
1.	Implements and monitors varied interlinking process-operations under pre-planned instructions.	S	E	ET	(T)	O
2.	Directs investigations concerned with complex process-operations ("trouble-shooting").	S	(E)	ET	T	O
3.	Adjusts process-operations to maintain a precise, routine functioning.	S	E	ET	(T)	O
4.	Develops "quality-control", structure for monitoring complex process-operations.	S	(E)	ET	T	O
5.	Concerned with "whys and hows" of complex process-operations in terms of their versatility and practicability.	S	(E)	ET	T	O
6.	Has moderate vertical, direct-line influence and limited horizontal staff influence.	S	E	(ET)	T	O
7.	Concerned with the effectiveness of operational systems applications to complex functions.	S	(E)	ET	T	O
8.	Has wide-range vertical and horizontal staff influence, limited direct-line influence.	(S)	E	ET	T	O
9.	Concerned with "whys and hows" of routine process-operations in terms of their efficiency and effectiveness.	S	E	(ET)	T	O
10.	Generates and monitors process-designs for exploring the unknown.	(S)	E	ET	T	O
11.	Directs investigations of probable (possible) adaptations of broad principles to varied complex process-operations	(S)	E	ET	T	O

FUNCTION/RESPONSIBILITY/TASK				
12. Has limited vertical direct-line influence and limited horizontal staff influence.	S	E	ET	(O)
13. Concerned with "whys and hows" of complex process-operations in terms of their efficiency and effectiveness.	S	(E)	ET	O
14. Concerned with maintaining specific standards in routine process-operations.	S	E	ET	(O)
15. Concerned with assembling comprehensive data-input capable of reflecting status of on-going complex process-operations.	S	(E)	ET	O
16. Explores the new frontiers related to process-operations.	(S)	E	ET	O
17. Concerned with generating generalized trends, principles, and concepts relevant to process-operations.	S	(E)	ET	O
18. Maintains a varied, adaptive, interchanging set of process-operations.	S	E	(ET)	O
19. Implements and monitors routinized process-operations according to pre-planned instructions.	S	E	(ET)	O
20. Concerned with assembling limited range of data-input reflecting status of on-going process-operations.	S	E	(ET)	O
21. Creates prototypes for complex process-operations.	(S)	E	ET	O
22. Directs investigations concerned with "trouble-shooting" a limited variety of process-operations.	S	E	(ET)	O
23. Concerned with "whys and hows" of general process-operations with particular emphasis on their utility.	S	(E)	ET	O
24. Directs investigations of broad principles underlying general process-operations.	S	(E)	ET	O
25. Generates and monitors process-designs directed toward meeting "needs."	S	(E)	ET	O
26. Concerned with assembling wide-range data-input related to establishing generalized principles and applications.	(S)	E	ET	O
27. Generates innovative features in maintaining and monitoring complex process-operations.	S	(E)	ET	O

FUNCTION/RESPONSIBILITY/TASK					
28. Has wide-range vertical direct-line influence, moderate horizontal staff influence.	S	(E)	ET	T	0
29. Concerned with assembling comprehensive data-input capable of reflecting potential/ capability of complex process-operations.	S	(E)	ET	T	0
30. Concerned with "whys and hows" of general process-operations irrespective of their apparent utility.	(S)	E	ET	T	0
31. Has wide-range vertical, direct-line influence, limited horizontal staff influence	S	(E)	ET	T	0
32. Concerned with implementing specific standards for varied process-operations.	S	E	(ET)	T	0
33. Concerned with assembling routinized, specific data-input reflecting status of on-going process-operations.	S	E	ET	(T)	0
34. Directs investigations concerned with "trouble-shooting" a specific, routine set of process-operations.	S	E	(ET)	T	0
35. Adapts "needs" and process-designs to operational systems.	S	(E)	ET	T	0

HIGHLIGHTS FROM THE FINDINGS:

A. Emphases of the Research-Production Team

1. "Ideas"....maximal for scientist and engineer.
2. "Analytical Solutions"...maximal for scientist and engineer.
3. "Applied Solutions"...maximal for engineering and engineering technologist.
4. "Applications"...maximal to substantial for engineer and engineering technologist.
5. "Data-gathering"...substantial to maximal for engineer and engineering technologist.
6. "Evaluation"...maximal for scientist and engineer.
7. "Sphere of Influence"...maximal for scientist and engineer.
8. "Physical Skills"...maximal for technician and operator.
9. "Educational Training"...maximal for scientist and engineer.

B. Engineering Technologist "Needs" (5 or higher on Table 3)

1. "Engineering Qualities"...Basic Physics, Basic Chemistry, Basic Calculus, Basic Spoken Communication, Basic Written Communication, Basic Data-Processing, Basic Graphics.
2. "Management Qualities"...short-range plans, responsibility, accountability, choose subordinates, train personnel, evaulate personnel, motivate personnel.
3. "Problem-Solving Qualities"...observational skill, routine observation, reporting efficiency, trend analysis, production of new ideas, translation to processing, general library systems, trouble-shooting.
4. "Self-Directing Qualities"...strong energy supply, resiliency, sustained drive, adapt to emergency, positive attack to barriers, effective time use, unwind easily, basic learning tools use, tolerance of differences.
5. "Human Relations Qualities"...dignity toward others, willing to interact with others, effective in communication, acceptance of others, sense of satisfaction, positive feelings, reaction to hurt/stress, listening effectiveness, leader and follower.
6. "Cultural/Creative Qualities"...self-discipline, reaction to new ideas, knowledge versatility, intellectual curiosity, rise to positive challenges, effectively time-oriented, commitment.

C. Production Management "Needs" (5 or higher on Table 4)

1. "Engineering Qualities"...Basic Spoken Communication, Basic Written Communication, Basic Data-Processing, Basic Graphics, Basic Systems Theory, Basic Ecological Control, Basic Engineering Economics.
2. "Management Qualities"...all except Basic Commercial Law.
3. "Problem-Solving Qualities"...all except General Library Systems.
4. "Self-Directing Qualities"...all.
5. "Human Relations Qualities"...all.
6. "Cultural/Creative Qualities"...all except conventionality, range of interests, "critical incident" use, and integrated basic philosophy.

HIGHLIGHTS FROM THE FINDINGS (Continued)

D. Proper Man for "Qualities" (Table 5)

1. "Engineering Qualities"....predominately - the engineer - except for Basic Spoken Communication, Basic Written Communication, and Basic Graphics, which are related to the engineering technologist, also.
2. "Management Qualities"...predominately - the engineer - except for line relationships and short-range plans, which relate to the engineering technologist, also.
3. "Problem-solving Qualities"...the engineering technologist includes observational skill, analysis of day-to-day, routine observation, reporting efficiency, effective data-handling, trend analysis, production of new ideas, translation to processing, trouble-shooting.
4. "Self-Directing Qualities"...predominately - the engineer - except for adapt to emergency and unwind easily, which relate to engineering technologist, also.
5. "Human Relations Qualities"...predominately - the engineer - except for acceptance of others, involvement with others, and leader and follower, which relate to the engineering technologist, also.
6. "Cultural/Creative Qualities"...predominately - the engineer - except for conventionality, which relates to the engineering technologist.

E. Research/Production Team Involvements (Table 6)

1. Scientist....wide vertical/horizontal staff influency, limited direct-line, exploration of the unknown, adaptation of broad principles to complex process-operations, exploration of new frontiers, creation of prototypes, wide-range data-input for generalizing, "whys & hows" irrespective of utility.
2. Engineer...complex trouble-shooting, quality-control, "whys & hows" for practicality, operating effectiveness of complex systems, "whys & hows" in terms of effectiveness, data-inputfor complex on-going processes, generalized trends, "whys & hows" of general process/operations, investigations related to broad process/operations, process-designs to meet "needs", innovations in maintaining complex process/operations, wide vertical/horizontal line influence, moderate staff influence, data analysis of complex process/operations, and adapts "needs"/process-designs to operational systems.
3. Engineering Technologist...moderate vertical/horizontal staff influence, limited line influence, "whys & hows" of routine process/operations, maintenance of interchanging set of process/operations, applications of pre-planned instructions, limited range of data-input, "trouble-shooting" on limited process/operations, implementing of "trouble-shooting" on specific, routing process/operations.
4. Technician...implementing pre-planned instructions, maintenance of precise, routine functions, and limited data-input on routine process/operations.
5. Operator...limited line and staff influence, and maintenance of specific standards in routine process/operations.

PART II

"DETAILED PROFILE REPORT"

THE RESEARCH-PRODUCTION TEAM:
DIRECTIONS, EXPECTATIONS, AND IMPLICATIONS

PART II
DETAILED PROFILE REPORT

Joics B. Stone

August 1975

In Part I, the preliminary report, several features were discussed. These included:

1. The introduction and rationale related to a developmental conceptualization of the research-production team and its increasing involvement, with "Ecotility" ... the economical utilization of all of our material and human resources based on intricately validated priorities.

2. The nature of the sample of respondents. 202 manufacturing persons, 176 construction persons, and 75 engineering faculty persons provided data for analysis. These persons were drawn from 262 different organizations.

3. The emphases expected from various members of the research-production team was presented in Table 2 and provided the conclusions that scientists and engineers were expected to emphasize creative, analytical, and evaluative aspects of the research-production efforts. Engineers and engineering technologists emphasized applied aspects, and data-gathering; the engineer from the design side and the engineering technologist from the application/production side.

4. Then followed a presentation in Tables 3, 4, and 5 of the consensus of the total sample as to features and functions for the engineering technologist to have, those important for production management, and the proper team member for the various qualities presented.

5. And last, a presentation was made as to the appropriate team member to emphasize various functions/responsibilities/tasks.

The present discussion reviews in greater detail the findings of 4 and 5, above. This review is concerned not with the consensus of Part I, but with the degree of agreement of the three (3) respondent groups.

The basic data for this review are contained in Tables 7 and 8, following. A review of Table 7 provides these observations pertaining the opinions of what the "engineering technologist needs":

TABLE 7
RESEARCH/PRODUCTION TEAM QUESTIONNAIRE

MFG □ CONSTR △ FACULTY ○

ENGINEERING QUALITIES: Record your response by circling the one you choose to mark in each instance.	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
1. Applications of Basic Physics	1	2	3	N	S	M	E	ET	T	1
2. Applications of Basic Chemistry	1	2	3	N	S	M	E	ET	T	2
3. Applications of Basic Calculus	1	2	3	N	S	M	E	ET	T	3
4. Applications of Basic Spoken Communication	1	2	3	N	S	M	E	ET	T	4
5. Applications of Basic Written Communication	1	2	3	N	S	M	E	ET	T	5
6. Applications of Basic Objective Data-Processing	1	2	3	N	S	M	E	ET	T	6
7. Applications of Basic Aerospace Engineering	1	2	3	N	S	M	E	ET	T	7
8. Applications of Basic Civil Engineering	1	2	3	N	S	M	E	ET	T	8
9. Applications of Basic Electrical/ Electronic Engineering	1	2	3	N	S	M	E	ET	T	9
10. Applications of Basic Industrial Engineering	1	2	3	N	S	M	E	ET	T	10
11. Applications of Basic Mechanical Engineering	1	2	3	N	S	M	E	ET	T	11
12. Applications of Basic Manufacturing Engineering	1	2	3	N	S	M	E	ET	T	12
13. Applications of Basic Spatial Visualization (Graphics)	1	2	3	N	S	M	E	ET	T	13

TABLE 7, cont'd

MFG □ CONSTR △ FACULTY ○

ENGINEERING QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
14. Applications of Basic Systems Theory	1	2	3	N	S	M	E	ET	T	14
15. Applications of Basic Ecological (Environmental) Control	1	2	3	N	S	M	E	ET	T	15
16. Applications of Basic Engineering Economics	1	2	3	N	S	M	E	ET	T	16
17. Applications of Basic Design Theory	1	2	3	N	S	M	E	ET	T	17
MANAGEMENT QUALITIES										
1. Functioning in Line Relationships	1	2	3	N	S	M	E	ET	T	1
2. Functioning in Staff Relationships	1	2	3	N	S	M	E	ET	T	2
3. Functioning with Formalized Functional Controls	1	2	3	N	S	M	E	ET	T	3
4. Formulating of Short-Range Plans	1	2	3	N	S	M	E	ET	T	4
5. Formulating of Long-Range Plans	1	2	3	N	S	M	E	ET	T	5
6. Ability to Advise and Counsel Objectively	1	2	3	N	S	M	E	ET	T	6

TABLE 7, cont'd

MFG □ CONSTR △ FACULTY ○

MANAGEMENT QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
7. Effective Delegating of Assignments	1	(2)	3	N	S	(M)	(E)	ET	T	7
8. Acceptance of Responsibility for Actions	1	(2)	△3	N	S	(M)	(E)	ET	T	8
9. Acceptance of Accountability for Decisions	1	△2	□3	N	S	(M)	(E)	ET	T	9
10. Ability to Choose Subordinates Wisely	1	△2	□3	N	S	(M)	(E)	ET	T	10
11. Ability to Train Peers and Subordinates Effectively	1	△2	□3	N	S	(M)	(E)	ET	T	11
12. Ability to Evaluate Other's Performance Objectively	1	△2	□3	N	S	(M)	(E)	ET	T	12
13. Ability to Motivate Peers and Subordinates	1	△2	□3	N	S	(M)	(E)	ET	T	13
14. Preparation of Daily/Weekly Agendas	1	△2	3	N	S	(M)	(E)	△ET	T	14
15. Ability to Conduct Peer and/or Subordinate Conferences	1	△2	□3	N	S	(M)	(E)	ET	T	15
16. Application of Basic Accounting Principles	△1	□2	3	N	□S	(M)	(E)	ET	T	16
17. Application of Basic Commercial Law Principles	△1	□2	3	N	(S)	M	(E)	△ET	T	17

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TABLE 7, cont'd

MFG □ CONSTR △ FACULTY ○

PROBLEM-SOLVING QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
1. Observational Skill Focus on Details/Totalities	1	2	3	N	S	M	E	ET	T	1
2. Application of Intellectual Skills to Practical and Theoretical	1	2	3	N	S	M	E	ET	T	2
3. Develop Concepts and Meanings on a Realistic Base	1	2	3	N	S	M	E	ET	T	3
4. Determine "Priorities" on Logical Objective Basis	1	2	3	N	S	M	E	ET	T	4
5. Ability to Analyze and Generalize Day-to-Day Activities	1	2	3	N	S	M	E	ET	T	5
6. Accurately Observes Routine Activities	1	2	3	N	S	M	E	ET	T	6
7. Application of Suspended and Empirical Judgment	1	2	3	N	S	M	E	ET	T	7
8. Generates Clear Reports of Activities and Processes	1	2	3	N	S	M	E	ET	T	8
9. Generates Effective Designs for Studying Problems	1	2	3	N	S	M	E	ET	T	9
10. Use of Effective Data-Handling Processes	1	2	3	N	S	M	E	ET	T	10
11. Determination of "Trends" in Production Processes/ Output	1	2	3	N	S	M	E	ET	T	11

TABLE 7, cont'd

MFG □ CONSTR △ FACULTY ○

PROBLEM-SOLVING QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
12. Generating of "new" Ideas for Production Operations	1	2	3	N	S	M	E	ET	T	12
13. Translating of "new" Ideas Into Processes/Applications	1	2	3	N	S	M	E	ET	T	13
14. Use of General Library Systems in Handling Problems	1	2	3	N	S	M	E	ET	T	14
15. Ability to Diagnose (Trouble-Shoot) Production Problems	1	2	3	N	S	M	E	ET	T	15
INTRA-PERSONAL (SELF-DIRECTING) QUALITIES										
1. Strong Physical/Emotional Energy Supply	1	2	3	N	S	M	E	ET	T	1
2. Bounces Back Readily in Response to Time/Energy Pressures	1	2	3	N	S	M	E	ET	T	2
3. Maintains Strong "Drives" on Sustained Basis	1	2	3	N	S	M	E	ET	T	3
4. Adapts Readily to Emergency Situations	1	2	3	N	S	M	E	ET	T	4
5. Has Sustained Long-Range Basic Goal Structure	1	2	3	N	S	M	E	ET	T	5
6. Attacks "Barriers" Positively and Directly	1	2	3	N	S	M	E	ET	T	6
7. Deals with His World with a Sense of Appreciation	1	2	3	N	S	M	E	ET	T	7

TABLE 7, cont'd

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INTRA-PERSONAL (SELF-DIRECTING) QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
8. Expects Maximum (Optimism) from Life and Work	1	2	3	N	S	M	E	ET	T	8
9. Personal Value-System Based on High-Value Elements	1	2	3	N	S	M	E	ET	T	9
10. Reacts to Annoyance with Mature Sense of Humor	1	2	3	N	S	M	E	ET	T	10
11. Effectively Plans and Controls His Time	1	2	3	N	S	M	E	ET	T	11
12. Easily "Unwinds" in Day-to-Day Activities	1	2	3	N	S	M	E	ET	T	12
13. Effectively Uses Basic Tools (Reading, Thinking, etc.)	1	2	3	N	S	M	E	ET	T	13
14. Reacts to Differing or Opposing Views Tolerantly	1	2	3	N	S	M	E	ET	T	14
INTERPERSONAL (HUMAN RELATIONS) QUALITIES										
1. Interacts with Dignity Toward Himself and Others	1	2	3	N	S	M	E	ET	T	1
2. Willing to Interact with All Kinds of People	1	2	3	N	S	M	E	ET	T	2

TABLE 7, cont'd

MFG □ CONSTR △ FACULTY ○

INTERPERSONAL (HUMAN RELATIONS) QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
3. Communicates with Others Fluently and Clearly	1	2	3	N	S	M	E	ET	T	3
4. Accepts Others as They are without Suspicion	1	2	3	N	S	M	E	ET	T	4
5. Comfortable in a Wide Range of Interpersonal Settings	1	2	3	N	S	M	E	ET	T	5
6. Exhibits Effective, Gregarious Involvement with Others	1	2	3	N	S	M	E	ET	T	6
7. Handles Realities of Success/ Failure with Confidence	1	2	3	N	S	M	E	ET	T	7
8. Sense of Satisfaction from Daily Activities	1	2	3	N	S	M	E	ET	T	8
9. Approaches Daily Activities with Positive Feelings	1	2	3	N	S	M	E	ET	T	9
10. "Rolls" with Physical/Emotional Hurt (Rides it Out)	1	2	3	N	S	M	E	ET	T	10
11. Effective Listener in Interacting with Others	1	2	3	N	S	M	E	ET	T	11
12. Effective Teacher in Interacting with others	1	2	3	N	S	M	E	ET	T	12
13. Effective in Leading and Following	1	2	3	N	S	M	E	ET	T	13

TABLE 7, cont'd

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SUPRA-PERSONAL (CULTURAL/CREATIVE) QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
1. Anchors Ethical Principles To Idealistic Base	1	2	3	N	S	M	E	ET	T	1
2. Employs Effective Self-Discipline (Internalized)	1	2	3	N	S	M	E	ET	T	2
3. Accepts Prevailing Practices and Customs Readily	1	2	3	N	S	M	E	ET	T	3
4. Exhibits Broad Range of Personal Interests	1	2	3	N	S	M	E	ET	T	4
5. Reacts to "New" Ideas/Practices with Open Mind	1	2	3	N	S	M	E	ET	T	5
6. Exhibits a Wide Range of Knowledge Competencies	1	2	3	N	S	M	E	ET	T	6
7. Employs Active Intellectual Curiosity	1	2	3	N	S	M	E	ET	T	7
8. Rises to Positive Challenges in Daily Activities	1	2	3	N	S	M	E	ET	T	8
9. Effectively "Time-Oriented" (Sense of Past, Present, Future)	1	2	3	N	S	M	E	ET	T	9
10. Easily Generates "Brainstorming"	1	2	3	N	S	M	E	ET	T	10
11. Effectively Uses "Critical Incident" Techniques	1	2	3	N	S	M	E	ET	T	11

TABLE 7, cont'd

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SUPRA-PERSONAL (CULTURAL/CREATIVE) QUALITIES	ENGINEERING TECHNOLOGIST NEEDS			PRODUCTION MANAGEMENT NEEDS			PROPER MAN FOR JOB			
	LITTLE 1	2	MUCH 3	NO	SOME	MUCH	ENGR.	ENGR. TECHNOL.	TECHN.	
12. Exhibits an Integrated Basic Philosophy of Life	1	2	3	N	S	M	E	ET	T	12
13. Accepts Personal Responsibility (Concern) for Commitment	1	2	3	N	S	M	E	ET	T	13

A. Engineering Qualities

1. All three groups (manufacturing, construction, and faculty) agreed that these qualities were needed to a moderate degree:

   a. applications of basic civil engineering.
   b. applications of basic electrical/electronic engineering.
   c. applications of basic systems theory.
   d. applications of basic ecological (environmental) control.
   e. applications of basic engineering economics.
   f. applications of basic design theory.

2. These items were considered to be essential by the manufacturing group but only moderately needed by the construction and faculty groups:

   a. applications of basic physics.
   b. applications of basic chemistry.
   c. applications of basic calculus.
   d. applications of basic industrial engineering.
   e. applications of basic mechanical engineering.

3. These features were considered essential by the faculty, but moderate by the other two groups:

   a. applications of basic written communications.
   b. applications of basic data-processing.

4. This item was essential to the construction group, but moderate to the other two:

   a. applications of basic spatial visualization (graphics).

5. This item was considered non-essential by the construction group and moderate by the others:

   a. applications of basic aerospace engineering.

6. This item was considered non-essential by the constrtion group, moderate by the faculty, and essential by the manufacturing group:

   a. applications of basic manufacturing engineering.

B. Management Qualities

1. These items were considered to be moderately needed by all three groups:

   a. functioning in staff relationships.
   b. ability to advise and counsel objectively.
   c. effective delegating of assignments.
   d. preparation of daily/weekly agendas.

2. These qualities were considered essential by manufacturing and moderate by the other groups:

   a. functioning in line relationships.
   b. acceptance of accountability for decisions.
   c. ability to choose subordinates wisely.
   d. ability to train peers and subordinates effectively.
   e. ability to motivate peers and subordinates.
   f. ability to evaluate others' performance objectively.
   g. ability to conduct peer and/or subordinate conferences.

3. These features were deemed essential by the construction and manufacturing groups but moderate by the faculty:

   a. formulating of short-range plans.
   b. acceptance of responsibility for actions.

4. These items were considered non-essential by construction and moderate by the others:

   a. applications of basic accounting principles.
   b. applications of basic commercial law principles.

5. This quality was considered non-essential by construction, moderate by faculty, and essential by manufacturing:

   a. functioning with formalizaed functional controls.

6. This feature was deemed non-essential by construction and faculty, but moderate by manufacturing:

   a. formulating of long-range plans.

C. Problem-solving qualities

1. These qualities were considered to be essential by all three groups:

   a. generates clear reports of activities and processes.
   b. ability to diagnose (trouble-shoot) production problems.

2. These items were moderate for all three groups:

   a. develop concepts and meanings on a realistic base.
   b. ability to analyze and generalize day-to-day activities.
   c. application of suspended and empirical judgment.
   d. generate effective designs for studying problems.

3. These items were essential for manufacturing and moderate for the other groups:

   a. application of intellectual skills to practical and theoretical.
   b. determine "priorities" on logical objective basis.
   c. generate "new" ideas for production operations.
   d. translate "new" ideas into processes/applications.

4. This item was essential for manufacturing and construction, but moderate for faculty:

   a. observational skill focus on details/totalities.

5. This quality was essential to manufacturing and faculty, but moderate for construction:

   a. accurately observes routine activities.

6. This feature was essential for construction and moderate for the others:

   a. use of effective data-handling processes.

7. This quality was essential for construction and moderate for the others:

   a. determination of "trends" in production processes/ outputs.

8. This item was non-essential to construction group and moderate to the others:

   a. use of general library systems in handling problems.

D. Intra-personal (self-directing) Qualities

1. This quality was considered to be moderately essential by all three groups:

   a. has sustained long-range goal structure.

2. These qualities were deemed essential by manufacturing group and moderate by the other two:

   a. strong physical/emotional energy supply.
   b. maintains strong "drives" on a sustained basis.
   c. attacks "barriers" positively and directly.
   d. deals with his world with a sense of appreciation.
   e. expects maximum (optimism) from life and work.
   f. personal value-system is based on high-value elements.
   g. reacts to annoyances with mature sense of humor.

3. These features were considered essential by manufacturing and faculty groups and moderate by construction:

   a. bounces back readily in response to time/energy pressures.
   b. adapts readily to emergency situations.
   c. effectively plans and controls his time.
   d. easily "unwinds" in day-to-day activities.
   e. effectively uses basic tools (reading, thinking, etc.)
   f. reacts to differing views tolerantly.

E. Interpersonal (Human Relations) Qualities

1. These qualities were considered essential by manufacturing and faculty groups and moderate by construction:

   a. interacts with dignity toward himself and others.
   b. willing to interact with all kinds of people.
   c. communicates with others clearly and fluently.
   d. accepts others as they are without suspicion.
   e. sense of satisfaction from daily activities.
   f. approaches daily activities with positive feelings.
   g. "rolls" with physical/emotional hurt (rides it out).
   h. effective in leading and following.

2. These were considered essential by manufacturing and moderate by the other two groups:

   a. effective listener in interacting with others.
   b. effective teacher in interacting with others.

3. This feature was considered essential by the manufacturing group, moderate by faculty and non-essential by construction:

   a. comfortable in a wide range of interpersonal settings.

4. This item was deemed non-essential by the construction group and moderate by the others:

   a. exhibits effective, gregarious involvement with others.

5. This item was considered essential by the faculty and moderate by the others:

   a. handles realities of success/failure with confidence.

F. Supra-personal (Cultural/Creative) Qualities

1. These qualities were deemed to be moderately essential by all three groups:

   a. anchors ethical principles to idealistic base.
   b. accepts prevailing practices and customs readily.
   c. exhibits broad range of personal interests.
   d. effectively uses "critical incident" techniques.
   e. exhibits an integrated basic philosophy of life.

2. These features were considered essential by manufacturing and faculty and moderate by construction:

   a. employs effective self-discipline (internalized).
   b. reacts to "new" ideas/practices with an open mind.
   c. rises to positive challenges in daily activities.

3. These items were considered essential by manufacturing and moderate by the others:

   a. exhibits a wide range of knowledge competencies.
   b. employs active intellectual curiosity.
   c. effectively "time-oriented" (sense of past, present, future).

4. This feature was deemed essential by the faculty and moderate by the others:

   a. accepts personal responsibility (concern) for commitment.

5. This quality was considered non-essential by the faculty and moderate by the others:

   a. easily generates "brainstorming" outputs.

The second general inquiry reflected in Table 7 attended to the question of those qualities "production management needs." A review of the responses to that question follows.

A. Engineering Qualities

1. These qualities were deemed essential by all three groups:

   a. applications of basic spoken communications.
   b. applications of basic written communications.
   c. applications of basic engineering economics.

2. These items were considered moderately essential by all three groups:

   a. applications of basic aerospace engineering.
   b. applications of basic civil engineering.
   c. applications of basic electrical/electronic engineering.
   d. applications of basic industrial engineering.
   e. applications of basic manufacturing engineering.

3. These items were considered essential by construction and faculty and moderate by manufacturing:

   a. applications of basic data-processing.
   b. applications of basic systems theory.
   c. applications of basic ecological (environmental)control.

4. These items were considered essential by the faculty and moderate by the others:

   a. applications of basic mechanical engineering.
   b. applications of basic design theory.

5. This item was considered essential by manufacturing and construction and moderate by faculty:

   a. applications of basic spatial visualization.

6. These items were considered non-essential by construction and moderate by the others:

   a. applications of basic physics.
   b. applications of basic chemistry.

7. This feature was considered non-essential by construction and faculty and moderate by manufacturing:

   a. applications of basic calculus.

B. Management Qualities

1. All of the qualities were considered to be essential by all three groups except two qualities.

2. This item was considered essential by faculty and construction and moderate by manufacturing:

   a. application of basic accounting principles.

3. This feature was considered to be moderately essential by all three groups:

   a. application of basic commercial law principles.

C. Problem-solving Qualities

1. Most of the qualities were considered to be essential by all three groups with a few exceptions.

2. These qualities were considered essential by manufacturing and faculty and moderate by construction:

   a. application of intellectual skills to practical and theoretical.
   b. develop concepts and meanings on a realistic base.
   c. accurately observe routine activities.

3. These items were deemed essential by construction and faculty and moderate by manufacturing:

   a. application of suspended and empirical judgment.
   b. generates effective designs for studying problems.

4. This item was deemed essential by all three groups:

   a. use of general library systems in handling problems.

D. Intra-personal (Self-directing) Qualities

1. All of the qualities were considered to be essential by all three groups, except one item.

2. This item was considered to be essential by the manufacturing and faculty groups and moderate by construction:

   a. personal value-system based on high-value elements.

E. Interpersonal (Human Relations) Qualities

1. All of these qualities were deemed essential by all three groups, except two items.

2. This item was considered essential by manufacturing and faculty and moderate by construction:

   a. accepts others as they are without suspicion.

3. This item was deemed essential by manufacturing and faculty and moderate by construction:

   a. exhibits effective, gregarious involvement with others.

F. Supra-personal (Cultural/Creative) Qualities

1. These qualities were deemed essential by all three groups:

   a. employs effective self-discipline (internalized).
   b. reacts to "new" ideas/practices with open mind.
   c. exhibits a wide range of knowledge competencies.
   d. employs active intellectual curiosity.
   e. rises to positive challenges in daily activities.
   f. effectively "time-oriented" (sense of past, present, future).
   g. accepts personal responsibility (concern) for commitment.

2. These features were deemed moderate by all three groups:

   a. accepts prevailing practices and customs readily.
   b. effectively uses "critical incident" techniques.

3. These items were deemed essential by construction and moderate by the others:

   a. exhibits broad range of personal interests.
   b. exhibits an integrated basic philosophy of life.

4. This item was considered essential by construction and manufacturing and moderate by faculty:

   a. anchors ethical principles to idealistic base.

5. This item was considered essential by faculty and moderate by the others:

   a. easily generates "brainstorming" outputs.

The third general question for which data are presented in Table 7 asked "Who was the proper man for the job." The review of those data follows.

A. Engineering Qualities

1. All three groups considered the engineer to be "proper man" for all of these qualities, except three.

2. All three groups considered the engineering technologist the "proper man" for:

   a. applications of basic spatial visualization (graphics).

3. The construction and faculty groups considered the engineer to be "proper" and the manufacturing group considered the engineering technologist to be "proper" for:

   a. applications of basic spoken communication.

4. The engineer was deemed "proper" by manufacturing and faculty, the engineering technologist by construction for:

   a. applications of basic objective data-processing.

B. Management Qualities

1. The engineer was deemed "proper" by all three groups for all items, except a few.

2. The engineer was considered "proper" by manufacturing and faculty, the engineering technologist by construction for:

   a. functioning in staff relationships.
   b. preparation of daily/weekly agendas.
   c. application of basic commercial law principles.
   d. ability to advise and counsel objectively.

3. The engineer was considered "proper" by manufacturing, the engineering technologist by construction and faculty for:

   a. functioning in line relationships.

4. The engineer was considered "proper" by faculty, the engineering technologist by the other groups for:

   a. functioning with formalized functional controls.

5. All three groups considered the engineering technologist "proper" for:

   a. formulating of short-range plans.

C. Problem-solving Qualities

1. All three groups deemed engineer "proper" for:

   a. application of intellectual skills to practical and theoretical.
   b. develop concepts and meanings on a realistic base.
   c. determine "priorities" on logical objective basis.
   d. generates effective designs for studying problems.

2. All three groups considered engineering technologist "proper" for:

   a. accurately observes routine activities.
   b. ability to diagnose (trouble-shoot) production problems.

3. The engineer was considered "proper" by faculty, the engineering technologist by manufacturing and construction for:

   a. observational skill focus on details/totalities.
   b. ability to analyze and generalize day-to-day activities.
   c. translation of "new ideas" into processes/applications.
   d. use of effective data-handling processes.

4. The engineer was considered "proper" by faculty and construction, the engineering technologist by manufacturing for:

   a. application of suspended and empirical judgment.

5. The engineer was considered "proper" by construction, the engineering technologist by the other two for:

   a. generates clear reports of activities and processes.

6. The engineer was deemed "proper" by construction and faculty, the engineering technologist by manufacturing for:

   a. determination of "trends" in production processes/output.

7. The engineer was considered "proper" by manufacturing and faculty, the engineering technologist by construction for:

   a. use of general library systems for handling problems.

D. Intra-personal (Self-directing) Qualities

1. All three groups considered the engineer "proper" except for a few items.

2. The engineer was considered "proper" by construction and faculty, the engineering technologist by manufacturing for:

   a. bounces back readily in response to time/energy pressures.
   b. attacks "barriers" positively and directly.
   c. deals with his world with a sense of appreciation.
   d. effectively plans and controls his time.
   e. easily "unwinds" in day-to-day activities.

3. The engineer was considered "proper" by construction, the engineering technologist by manufacturing and faculty for:

   a. adapts readily to emergency situations.

E. Interpersonal (Human Relations) Qualities

1. All three groups considered the engineer "proper" for:

   a. willing to interact with all kinds of people.
   b. communicates with others fluently and clearly.
   c. comfortable in a wide range of interpersonal settings.

2. The engineer was deemed "proper" by construction and manufacturing the engineering technologist by faculty for:

   a. interacts with digity toward himself and others.

3. The engineer was deemed "proper" by construction, the engineering technologist by the other two for:

   a. accepts others as they are without suspicion.
   b. exhibits effective, gregarious involvement with others.

4. The engineer was deemed "proper" by construction and faculty, the engineering technologist by manufacturing for:

   a. handles realities of success/failure with confidence.
   b. sense of satisfaction from daily activities.
   c. approaches daily activities with positive feelings.
   d. "rolls" with physical/emotional hurt (rides it out).
   e. effective listener in interacting with others.
   f. effective teacher in interacting with others.
   g. effective in leading and following.

F. Supra-personal (Cultural/Creative) Qualities

1. The engineer was deemed "proper" by all three groups, except for a few qualities.

2. The engineering technologist was considered "proper" by all three groups for:

   a. accepts prevailing practices and customs readily.

3. The engineer was considered "proper" by construction and faculty, the engineering technologist by manufacturing for:

   a. exhibits broad range of personal interests.
   b. rises to positive challenges in daily activities.
   c. effectively uses "critical incident" techniques.

4. The engineer was considered "proper" by construction and manufacturing, the engineering technologist by faculty for:

   a. reacts to "new" ideas/practices with open mind.

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This section is concerned with the extent to which specific functions are appropriately performed by particular members of the Research/Production Team.

TABLE 8. Research/Production Team Involvements.

S . . . Scientist
E . . . Engineer
ET. . . Engineering Technologist
T . . . Technician
O . . . Operator

FUNCTION/RESPONSIBILITY/TASK					
1. Implements and monitors varied interlinking process-operations under pre-planned instructions.	S	E	(ET)	△T	O
2. Directs investigations concerned with complex process-operations ("trouble-shooting").	S	(E)	△ET	T	O
3. Adjusts process-operations to maintain a precise, routine functioning.	S	E	(ET)	△T	O
4. Develops "quality-control," structure for monitoring complex process-operations.	S	(E)	ET	T	O
5. Concerned with "whys and hows" of complex process-operations in terms of their versatility and practicability.	S	(E)	ET	T	O
6. Has moderate vertical, direct-line influence and limited horizontal staff influence.	△S	E	(ET)	T	O
7. Concerned with the effectiveness of operational systems applications to complex functions.	S	(E)	ET	T	O
8. Has wide-range vertical and horizontal staff influence, limited direct-line influence.	(S)	E	ET	T	O
9. Concerned with "whys and hows" of routine process-operations in terms of their efficiency and effectiveness.	S	E	(ET)	T	O
10. Generates and monitors process-designs for exploring the unknown.	(S)	E	ET	T	O

	FUNCTION/RESPONSIBILITY/TASK					
11.	Directs investigations of probable (possible) adaptations of broad principles to varied complex process-operations.	S	E	ET	T	O
12.	Has limited vertical direct-line influence and limited horizontal staff influence.	S	E	ET	T	O
13.	Concerned with "whys and hows" of complex process-operations in terms of their efficiency and effectiveness.	S	E	ET	T	O
14.	Concerned with maintaining specific standards in routine process-operations.	S	E	ET	T	O
15.	Concerned with assembling comprehensive data-input capable of reflecting status of on-going complex process-operations.	S	E	ET	T	O
16.	Explores the new frontiers related to process-operations.	S	E	ET	T	O
17.	Concerned with generating generalized trends, principles, and concepts relevant to process-operations.	S	E	ET	T	O
18.	Maintains a varied, adaptive, interchanging set of process-operations.	S	E	ET	T	O
19.	Implements and monitors routinized process-operations according to pre-planned instructions.	S	E	ET	T	O
20.	Concerned with assembling limited range of data-input reflecting status of on-going process-operations.	S	E	ET	T	O
21.	Creates prototypes for complex process-operations.	S	E	ET	T	O
22.	Directs investigations concerned with "trouble-shooting" a limited variety of process-operations.	S	E	ET	T	O
23.	Concerned with "whys and hows" of general process-operations with particular emphasis on their utility.	S	E	ET	T	O
24.	Directs investigations of broad principles underlying general process-operations.	S	E	ET	T	O
25.	Generates and monitors process-designs directed toward meeting "needs."	S	E	ET	T	O
26.	Concerned with assembling wide-range data-input related to establishing generalized principles and applications.	S	E	ET	T	O

	FUNCTION/RESPONSIBILITY/TASK					
27.	Generates innovative features in maintaining and monitoring complex process-operations.	S	E	ET	T	0
28.	Has wide-range vertical direct-line influence, moderate horizontal staff influence.	S	E	ET	T	0
29.	Concerned with assembling comprehensive data-input capable of reflecting potential/ capability of complex process-operations.	S	E	ET	T	0
30.	Concerned with "whys and hows" of general process-operations irrespective of their apparent utility.	S	E	ET	T	0
31.	Has wide-range vertical, direct-line influence, limited horizontal staff influence.	S	E	ET	T	0
32.	Concerned with implementing specific standards for varied process-operations.	S	E	ET	T	0
33.	Concerned with assembling routinized, specific data-input reflecting status of on-going process-operations.	S	E	ET	T	0
34.	Directs investigations concerned with "trouble-shooting" a specific, routine set of process-operations.	S	E	ET	T	0
35.	Adapts "needs" and process-designs to operational systems.	S	E	ET	T	0

A review of the data in Table 8 provides a variety of conclusions.

1. These functions were considered to be appropriate for the scientist by all three groups:

   a. generates and monitors process-designs for exploring the unknown.
   b. has wide-range vertical and horizontal staff influence, limited direct-line influence.
   c. explores the new frontiers related to process-operations.

2. These functions were considered to be appropriate to the engineer by all three groups:

   a. develops "quality control" structure for monitoring complex process-operations.
   b. concerned with "whys and hows" of complex process-operations in terms of their versatility and practicability.

c. concerned with effectiveness of operational systems applications to complex functions.
d. concerned with generating generalized trends, principles, and concepts relevant to process-operations.
e. generates and monitors process-designs directed toward meeting "needs".
f. has wide-range vertical, direct-line influence, limited horizontal staff influence.

3. All three groups considered the engineering technologist appropriate for:

a. concerned with "whys and hows" of routine process-operations in terms of their effectiveness and efficiency.
b. directs investigations concerned with "trouble-shooting" a limited variety of process-operations.
c. concerned with implementing specific standards for varied process-operations.
d. concerned with assembling routinized, specific data-input reflecting status of on-going process-operations.

4. There were no functions for technicians upon which all three groups agreed.

5. All three groups deemed appropriate for operators:

a. has limited vertical direct-line influence and limited horizontal staff influence.